Chung-Fu SHEN* & David E. BOUFFORD**: *Fagus hayatae* (Fagaceae) — A remarkable new example of disjunction between Taiwan and central China***

シェン C. F.*・D. E. ブフォード**: タイワンブナ — 台湾・中国大陸中部の隔離分布の新実例***

The discontinuous distribution of plants between Taiwan and central China is already well known. Volume 1 of the Flora of Taiwan (Li et al. 1975) and Kuo (1985) cite many examples of species of pteridophytes showing wide disjunction between Taiwan and central and southwestern China. In the gymnosperms the genus *Taiwania* Hayata (Taxodiaceae), with only two species, also exhibits this discontinuous pattern of distribution. *Taiwania cryptomerioides* Hayata is restricted to Taiwan, while the range of *T. flousiana* Gaussen includes only isolated populations in Yunnan, Guizhou and Hubei provinces in central and southwestern China (Tsui et al. 1978). In the flowering plants one well documented example of disjunction in the Onagraceae is found in *Circaea glabrescens* (Pamp.) Hand.-Mazz., which was collected once on Taiwan, but is frequent and often abundant in central China (Boufford 1983). These are just a few of the many examples of plants, most of which are well known, exhibiting this pattern of distribution. Additional examples are occasionally recognized in the course of monographic work on critical groups, but it is remarkable when new examples of this disjunction are discovered in conspicuous, well studied genera.

About two years ago C.-F. Shen noted similarities between a specimen labeled *Fagus lucida* Rehder & Wilson and collected on the 1980 Sino-American Botanical Expedition to western Hubei, China (no. *1485*), and deposited in the New York Botanical Garden (NY), and *F. hayatae* Palibin ex Hayata. Without access to authentic specimens of *F. hayatae* for comparison, however, the specimen was not annotated. Recently, after examining a second specimen of this collection in the Arnold Arboretum herbarium (A) and comparing it with

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a number of specimens of *F. hayatae* from Taiwan also housed at A, it became clear that *1980 Sino-Amer. Bot. Exped. 1485* fits very well within the range of variation of *F. hayatae* in both qualitative and quantitative characters. In the definitive, non-overlapping and decisively diagnostic characters, such as those in the key below, the identification of this specimen in our opinion is beyond doubt. *Fagus hayatae* was previously thought to be restricted to northern Taiwan; this new discovery represents a disjunction of about 1400 km between the two populations.

Since there have been no published reports of *Fagus hayatae* in mainland China, and *F. hayatae* has a very limited distribution even in Taiwan, it seems desirable to present a detailed comparison of *F. hayatae* and *F. lucida.* The following key and descriptions, based on reports in the literature (Anonymous 1972, Liao 1971, Lin & Liu 1965, Liu & Liao 1976, Shen 1984) and our own observations present the differences between them.

1. Vein axils on lower leaf surface with tufts of hairs, lower axils often with conspicuous glands; scales of cupules partly adnate to outer wall of cupule, free portion distinct, 1-3 mm long; nuts oblong to oblong-ovoid, concave triangular in cross section, upper portion winged along angles .... *F. hayatae.*
1. Vein axils on lower leaf surface without tufts of hairs, axils without glands; scales of cupules almost completely adnate to cupule wall, free portion absent or less than 1 mm long; nuts ovoid to narrowly ovoid, triangular or convex triangular in cross section, devoid of wings .... *F. lucida.*

Fagus hayatae Palibin ex Hayata. Bud scales, at least those toward apex, usually with short, grayish-white hairs at the tips. Petioles 4–8 mm long. Leaf blades 3-7×1.8–3.5 cm; petiole, midvein and at least the lower portion of secondary veins on upper surface of mature leaves with long white hairs, vein axils on lower leaf surface with tufts of long white hairs, the lower axils often with conspicuous resin-producing glands. Peduncle of cupule slender, usually 1 mm or less in diam., always densely covered with long grayish-white hairs. Cupule 4-valved, 6–10 mm long, containing 2 nuts; scales partly adnate to the cupule wall, free portion always evident, 1–3 mm long, and similar in appearance to those in most other species of *Fagus* (such as *F. grandifolia* Ehrh., *F. longipetiolata* Seem. and *F. sylvatica* L.). Nuts oblong to oblong-ovate due partly or entirely to the obvious widening of the wings located on the upper angles of the nut, 5–8 mm long, concave triangular in cross section.

Fagus lucida Rehder & Wilson. Bud scales without hairs at their tips, or at least hairs not easily observable. Petioles 5–15 mm long. Leaf blades 4.5–11 × 2.5–6 cm; petiole, midvein and secondary veins on upper surface of mature leaves mostly without long white hairs, vein axils on lower leaf surface without tufts of long white hairs and resin-producing glands. Peduncle of cupule thick, usually 1–1.5 mm in diam., glabrous or nearly so. Cupule (3–)4-valved, 7–14 mm long, containing 2 nuts (containing only one when 3-valved); scales almost completely adnate to the cupule wall to the extent that the free portion is usually not evident to the naked eye, usually a few tenths of a millimeter long, unlike other species of *Fagus* in that the outer wall of the cupule is beset with the short, cylindrical, fused portion of the scales. Nuts ovoid to narrowly ovoid, 7–15 mm long, the angles completely devoid of wings, triangular or even convex triangular in cross section, especially when there is only one nut in a cupule.

In Taiwan, *Fagus hayatae* shows a limited, scattered, and relic-like distribution within an area of about 1,000 km^2 in the mountains in the northern part of the island. Individual trees are found between 1,300 and 2,300 m (Shen 1984), but along ridges at elevations of ca. 1,500 to 1,800 m this beech outcompetes all other woody species and forms nearly pure stands. The lower portions of these stands are intermixed with *Trochodendron* Sieb. & Zucc., *Illicium* L., *Mahonia* Nuttall, *Adinandra* Jack, *Daphniphyllum* Blume, and others (Liao 1971). The common associates of the beeches in the nearly pure stands are *Yushania* (*Pleioblastus*) *niitakayamensis* (Hayata) H. Keng along the ridge tops and *Plagiogyria formosana* Nakai (*P. glauca* (Blume) Mett. var. *philippinensis* Christ) in the gaps (Liu & Su, 1972). In central China the only known collection (present report) of *F. hayatae* was made at an elevation of 2,050 m on a promontory on the southeast side of the Yingyu River above Taizishang (where it was growing with *Pinus* L.) in the Shennongjia Forest District in northwestern Hubei. Until additional collections and careful observations are made on the mainland it will be difficult to compare the vegetation and ecology of these two disjunct areas.

The most ancient and reliable *Fagus* fossils date back to the Oligocene (c.f. Tanai 1974, Manchester & Crane 1983), or even the late Eocene in northeastern

China (Hsu 1984), and are widespread throughout the northern hemisphere from the Miocene onward. The only possible geological evidence of *Fagus hayatae* on the Chinese mainland is in the fossil leaf described as *F. praelucida* Li & Guao, from the Pliocene of Jiangxi Province (Anonymous 1982). The authors of the name consider this specimen to be close to *F. lucida,* as reflected in the specific epithet. It is clear that the leaf margin and some other leaf characters of *F. lucida* and *F. hayatae* are far closer to each other than they are to any other extant species of *Fagus.* In our opinion, however, the fossil leaf resembles *F. hayatae* more than *F. lucida* in its smaller size and in the more strongly zig-zag appearance of the upper portion of the midvein. The locality where this fossil was collected, Nanfong, Jiangxi Province, is located between northern Taiwan and the Shennongjia Forest District in Hubei.

Overall, we consider *F. hayatae* to exhibit more advanced character states in both vegetative and reproductive features than most other species of the genus, and we have not seen reports of any other fossils that show resemblence to any organ of *F. hayatae* from pre-Pliocene strata. It therefore seems reasonable to assume the first evolutionary appearance of *F. hayatae* to be not prior to at least the late Oligocene or early Miocene, and perhaps even later. As is now generally known, the western half of Taiwan was connected with the southeastern Asian mainland from the Cretaceous to the Miocene (Li 1974) and there may possibly have been a brief opportunity for *F. hayatae* to reach Taiwan directly before the connection to the mainland was severed.

However, despite studies comparing the Upper Oligocene and earliest Miocene floras of Taiwan to the present mixed mesophytic forest of the Chinese mainland (Hsieh & Huang 1985, Wang 1961) and Huang's (1980) detailed pollen analysis of the Taiwan Miocene, there are no reports of fossil *Fagus* pollen in Taiwan before the Pleistocene. Although Taiwan was connected to the Asian mainland from the Cretaceous to the Miocene, and while it is possible that *F. hayatae* was more widespread and was growing on Taiwan at the end of that time, it is also possible that it did not reach the island until the Pleistocene when sea levels were considerably lower. Even though the geological history of *Fagus hayatae* on Taiwan is uncertain, the recent discovery of the species in central China is evidence that it was once more widespread in eastern Asia than it is at present.

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1980年湖北省西部で採集され，*Fagus lucida* とされていた標本は台湾から記載された *F. hayatae* であることが判明した。これにより中国大陸中部と台湾に隔離分布する植物に一例を加えたことになる。両種の検索表とくわしい記相文を新たに示す。なお江西省の鮮新世から記載された *F. praelucida* は，葉形からみて *F. lucida* よりも *F. hayatae* に近いものと考える。以上のことから *F. hayatae* は過去において現在より広く分布していたものが局限されたと推定する。

○若き日の原 寛博士の日記 (4)

昭和3年（1928）植物採集旅行表

1月5日　逗子桜山方面。7日逗子廓方面。

2月5日　逗子桜山。神武寺方面。20日西浦，芦谷方面。

3月19日　新宮附近。20日湯ノ峰附近。22日那智山。23日烏帽子山。29日伊東附近。30日伊東附近。

4月1日　蓮台寺附近。2日天城山脈。30日葉山。

5月5日　軽井沢，高原。6日愛宕山，高原。19日小瀬方面。27日軽井沢，小瀬，高原。

6月3日　逗子神武寺，法勝寺。10日鎌倉方面。24日逗子神武寺山。

7月11日　赤城登山。12日黒檜山，沼田行。14日谷川岳，清水峠。20日奈川渡～上高地。22日徳本峠。25日より軽井沢。28日碓氷峠。31日まで。

8月3日　出発。5日北海道札幌植物園。7日支笏湖畔。8日樽前山。9日登別温泉。11日旭川。12日樺太大泊。13日鈴谷岳。14日豊真山道。15日野田，羽母舞，登富津，荒鯉。16日野田。17日貝塚，大泊。18日稚内。19日大沼，函館。21日帰京。

9月22日　逗子桜山。

10月10日　上州古馬牧。14日逗子神武寺山。19日上州湯原。20日湯原，スキー場。22日湯原。24日顕微鏡を買う。（注：特記してある）

11月3日　葉山，一色南方。4日高雄山。16日逗子桜山。

昭和5年（1930）19才　1月4日　夕食後樺太の菅原繁蔵氏来り，種々話をした。

2月11日　11時頃平井が目黒でカゴタケを採ってきたので写真をとり，昼食後写生し調べた。

4月16日　学校を終り直ちに植物園へ中井先生を訪れ，又本田正次先生に御紹介下さった。4時半帰宅後直ちに川村先生の所へ行き，7時過帰宅，夕食後，腊葉整理。（注：中井博士との交流は前年から始まったようである。）　（続く）